MA82
.8 C213b0
NMNS

RESERVED/RÉSERVÉ

NOT TO BE TAKEN FROM THE ROOM
POUR LA CONSULTATION SUR PLACE

BIOME

A publication of the National Museum of Natural Sciences

Vol. 7:2 1987 ISSN 0712-9319

# How to Build Woolly Mammoths

*Editor's note: the following is adapted from a background paper by Dr. C.R. (Dick) Harington, Chief of the Museum's Paleobiology Division. Dick's collecting and research has led to the identification of about 65 species of ice age animals from the Yukon, some never recorded before in North America. He has published extensively and is a frequent contributor to BIOME.*

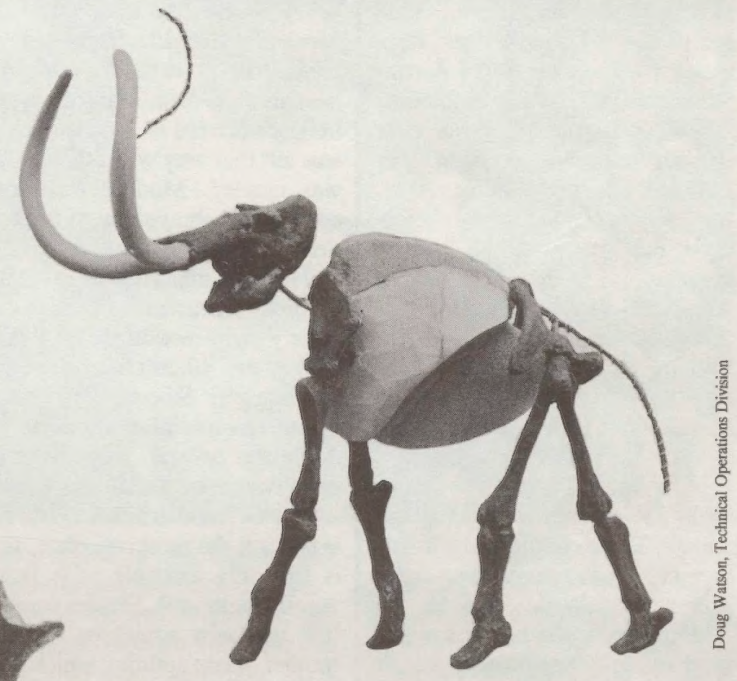
Woolly mammoths are often considered to be symbolic of the ice age in Canada (Quaternary — the last two million years) because of their large size, broad geographic distribution, relative abundance during the last glaciation and adaptation to cold environments. This summer, motorists and pedestrians in downtown Ottawa may be startled by the National Museum of Natural Sciences' latest contribution to the study of paleontology — a life-like, life-size group of these hairy elephants on display outside the Victoria Memorial Museum Building.

Each model (there are three — an adult male, an adult female and a baby) is based on a 1/12-scale Plasticine model built by artist/modeller Doug Watson in consultation with Dick Harington. The Plasticine models are, in turn, based on a great deal of research in the scientific literature, detailed examination and measurement of actual mammoth skeletons, and consultation with highly experienced Soviet and British paleontologists. In fact, if you were to X-ray one of the Plasticine models, you would see the outline of all the major "bones" inside, which were scaled down from measurements of real bones of an original mammoth skeleton. They were constructed from papier-maché (tusks were made from epoxy putty) and laid down on an exactly positioned metal armature or framework. Then the soft parts, such as muscle, skin and hair, were overlaid, based on information derived from rather well-preserved carcasses of woolly mammoths excavated from frozen ground in Siberia, as well as from several works of Paleolithic cave art from Europe that were considered particularly realistic.

A second phase of this project involved making life-size models of coloured, durable fibreglass that could withstand both the severest weather, and handling by spectators. This challenge was undertaken by a team under the direction of Ron Séguin, already well-known for his modelling of a life-size carnivorous dinosaur (*Stenonychosaurus* — see *BIOME* Vol. 3:1). This work involved making plastic casts of the 1/12-scale Plasticine models, cutting them serially from top to bottom leaving many cross sections, scaling these plastic sections to life-size plywood templates, reassembling the templates with appropriate horizontal spacing using Styrofoam sheets, then applying reinforced gypsum over the surface with careful attention to visual effect (particularly in sculpting such details as the eyes, hair on the ears, wind-ruffled hair on the body, shorter hair on parts of the trunk, nails on the feet, etc.). The next steps were to make latex rubber moulds from the life-size sculptures, and to prepare permanent casts in appropriately coloured fibreglass materials.

As mentioned above, the models are based on actual mammoth specimens. The adult male derives from a composite skeleton presently on display in the Smithsonian Institution, Washington, D.C., the bones of which were collected from frozen ground in the vicinity of

*(continued on page 2)*



Doug Watson, Technical Operations Division

*An X-ray of the Plasticine model would show the outline of all the major "bones" inside.*

Gerry Anderson, Technical Operations Division

*Each life-size model is based on a 1/12-scale Plasticine model. The adult male is in an alert posture, trunk held high.*

Ottawa is becoming an increasingly popular site for national and international meetings, including those of a scientific nature. Last summer, the International Ornithological Congress marked its 100th anniversary in this city. This year, the city will host the XII International Congress of the International Union for Quaternary Research (INQUA), to be held from July 31 to August 9.

Sponsored by the National Research Council of Canada, the Canadian Quaternary Association, and l'Association québécoise pour l'étude du Quaternaire, the Congress will bring together hundreds of scientists who are studying the ice age. The scientific programme will present over 30 special sessions and seven major symposia. Field excursions to outstanding sites in all parts of Canada that represent the effects of the ice age have been arranged as well.

Museum staff will lead field trips and present papers at the Congress. The Museum will also assist in the "social" aspect of the meeting: a special evening is planned for the official opening of the woolly mammoth exhibit — followed by an outdoor "buffalo barbecue" featuring a variety of succulent foods indigenous to the Americas!

National Museums of Canada Musées nationaux du Canada

NATIONAL MUSEUMS OF CANADA
MUSÉES NATIONAUX DU CANADA
LIBRARY – BIBLIOTHÈQUE

Canada

## EDITORIAL

# *Arctic Initiative*

The history of Canada has been vastly influenced by its arctic and boreal environments. Similarly, there has been a great emphasis on the research and exploration of northern Canada by the Museum staff. Indeed, some of Canada's greatest adventures took place and will take place in the north during research expeditions.

Several of our present staff members are known for their important research in the Arctic. Stewart MacDonald, ethologist, succeeded in convincing our government to declare the Polar Bear Pass a National Wildlife Area. Dr. Richard Harington, paleobiologist, this year won the Massey medal for his research in the Arctic. In 1985, Dr. Ed Bousfield, zoologist, was presented with the Public Service of Canada's Outstanding Achievement Award for his research, much of which is relevant to the Arctic.

What was the north like before today? What happened during the ice age? These questions are fundamental to our understanding of the present-day Arctic. We at the NMNS have embarked on a major programme of coordinated research in the Arctic. It will take at least two years to get the research plan and resources in place, but the first stages of this planning process will be given a wonderful kickoff by the opening of the outdoor exhibit featuring life-size, accurate models of three woolly mammoths, coinciding with the opening ceremonies of a major international meeting — the XII International Congress of the International Union for Quaternary Research.

As a spin-off of this conference, much of which will deal with the ice age history of the Arctic, a workshop will be held later in the year inviting selected scientists to help us define the most important gaps in man's knowledge of the Arctic. We will include fields as diverse as geology, mineralogy, paleobiology, botany and zoology. Each scientist will develop a definition of what questions we need to answer to be able to better understand the north. From that definition, research institutions across Canada, including our own, will be able to create research plans to match their own skills and resources. At the NMNS, we will develop a long-range research plan. Because we are all in the same institution, we will be able to combine efforts from many disciplines, cooperating in field work, technical knowledge, and logistics. By developing the various plans as the result of a major workshop, we anticipate even more opportunities for cooperation with other institutions than we now enjoy.

In today's world, interdisciplinary science often is the only way to fathom the increasingly intricate and complex questions that we need answered. The NMNS intends to be a part of the modern world of discovery and adventure.

Alan R. Emery
Director

*(continued from page 1)*

Fairbanks, Alaska, during the first half of this century. It probably represents nearly the maximum size of this species of mammoth. In life, it probably weighed about six metric tonnes — the weight of a living African elephant of a similar size.

The female is based on the Whitestone Mammoth, a relatively complete skeleton from the northern Yukon (the richest area for collecting ice age vertebrate remains in Canada). This female may have weighed about four metric tonnes. The right tusk had been broken off near the socket — perhaps while she was trying to lift something heavy — because there was evidence of a lever-like fracture. This break had occurred well before the animal died, natural wear having occurred on its edges, so it was left that way when the model was created. Modern elephants occasionally show similarly broken tusks.

The baby mammoth is based on "Dima," the carcass of an approximately eight-month-old male that died some 40,000 years ago in northeastern Siberia. The story behind this specimen is fascinating. Although several partially preserved carcasses of adult mammoths have been found in Siberia, "Dima" is perhaps the most complete, and is the only example of a baby woolly mammoth. Studies suggest that the baby somehow lost his mother in late autumn, which was fatal because he was not yet weaned. After several days in a very weakened condition (he had used his stores of body fat, and his ribs show pathetically), he apparently stumbled into a mucky pit, dying there of exhaustion and starvation. The body was quickly buried by flash floods or slumping earth and preserved in nature's deep-freeze. "Dima" may have weighed about 90 kg at death. Presumably the healthy baby, as shown in the model, would weigh about 115 kg. Doug Watson and Dick Harington were worried initially that the 1/12-scale model seemed "too cute." But after rechecking measurements derived from a scientific monograph on "Dima" and after analysing data gleaned from a series of excellent photographic prints of the carcass, Doug and Dick were satisfied that the model was as close to reality as they could get. And, on second thoughts, most young mammals — including baby elephants — are cute!

It was decided that the adult male, because he was largest (and had the longest tusks), would be the greatest challenge in scaling-up the small Plasticine models to life size, and that he should be tackled first to test techniques that Ron Séguin planned to use. The model, which measures 3.5 m to the top of the head, 4.7 m to the top of the trunk, and is 4.7 m long, was so big when put together that the complete trunk would not fit into the studio where the work was carried out. Furthermore, special scaffolding had to be erected to allow the workers access for basic construction and surface sculpturing. Clearly, many office workers who happened to pass by the studio when the doors were open stared in wonder and awe at the sight of this massive animal!

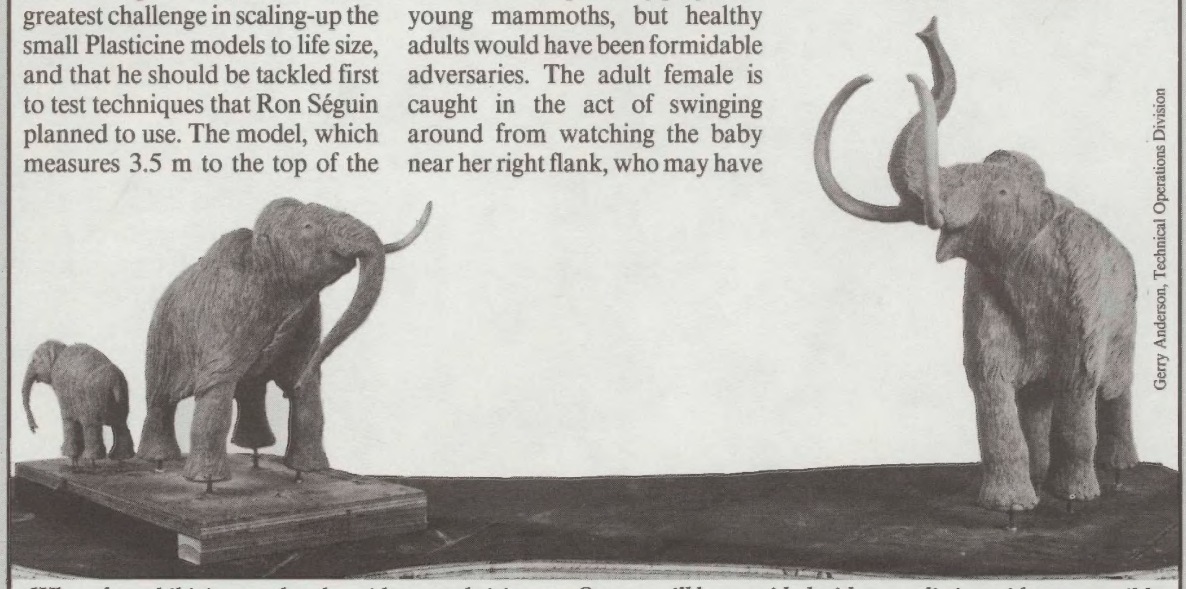
Bruno Schlumberger, *The Citizen*

*Doug Watson, top, Sandra Taylor and Grant Laturnus are dwarfed by the life-size sculpture they are working on.*

Although woolly mammoths were commonly found in northern North America and Eurasia during the last glaciation, they could not cope with the rapidly changing environment and increasing human predation towards the close of this glaciation, and the species became extinct about 11,000 years ago. When the exhibit is completed, residents and visitors to Ottawa will be provided with as realistic an idea as possible of the appearance and behaviour of these ice age elephants. The adult male is in an alert posture, trunk held high, testing the air for scent or possibly trumpeting — perhaps a sign that a predator is near. Scimitar cats and American lions probably preyed on young mammoths, but healthy adults would have been formidable adversaries. The adult female is caught in the act of swinging around from watching the baby near her right flank, who may have intentions of wandering off should the mother be distracted by the approaching male. Appropriate landscaping will suggest the rigorous, tundra-like environment normally occupied by woolly mammoths; and the windswept hair of the adults (the baby is sheltered from the wind at his mother's flank) indicates the sometimes strong winds tearing off the margins of nearby ice sheets.

The inauguration of this exhibit will coincide with the XII International Congress of the International Union for Quaternary Research (see inset). The National Museum of Natural Sciences has tried to bring to life again a magnificent, extinct species for the benefit of the residents of Ottawa, participants in the Congress, and many others who will visit Canada's capital over the coming decades.

Readers who wish to find out more about the natural history of woolly mammoths and other mammals of the Quaternary can call or write the Museum Information and Resource Centre for free copies of *Neotoma* issues: no. 17, *The Woolly Mammoth*, no. 19, *The American Mastodon*, and no. 20, *The Giant Beaver*.



Gerry Anderson, Technical Operations Division

*When the exhibit is completed, residents and visitors to Ottawa will be provided with as realistic an idea as possible of the appearance and behaviour of these ice age elephants.*

# *Ten Years in the Volunteer Programme*

With a fanfare of trumpets and a roll of drums, we proudly announce that NMNS volunteers:

Agnes Burnett
Mary Collins
Phyllis Esdon
Thérèse Letarte
Jane Merlin
Arlene Neilson
Phyllis Robertson
Joan Rowed
Helen Sallmen
Josette Tousignant
Margot Watt

have been assisting Museum visits by thousands of children, from pre-school to high school, for ten years. The Museum's director, Dr. Alan Emery, recently presented each of these volunteers with a representative Canadian mineral mounted on a base in special recognition of long service. We also wish to publicly thank them for their invaluable contributions to our volunteer programme.

If you wish to find out more about the volunteer programme, call Mary Anne Dancey at 995-9538. You may choose to offer your time to teach children, or you may assist our scientific staff. We don't require an advanced degree, just a simple interest in the natural sciences.

**BIOME**

**Editor-in-Chief:**
Nick Bélanger

**Acknowledgements:**
Bonnie Livingstone
Annie J. Ollivier

**Art Direction:**
Design Division,
NMNS

**Graphic Design:**
Acart Graphic Services, Inc.

**Illustrations:**
Charles Douglas
Norman Takeuchi

*Cette publication est également offerte en français*

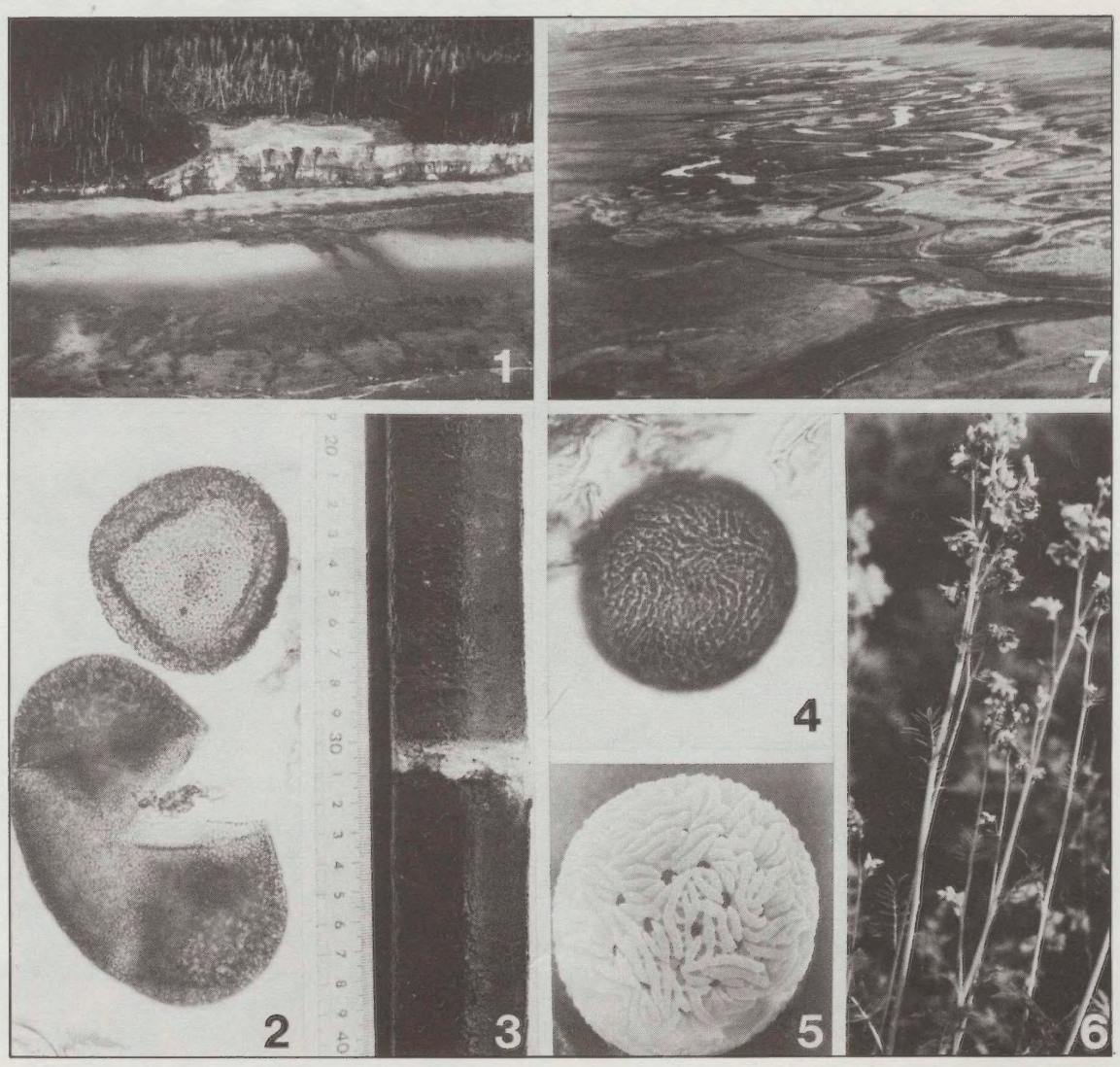
Comments and questions should be directed to:

BIOME
National Museum of Natural Sciences
Ottawa, Ontario
K1A 0M8

© National Museum of Natural Sciences, 1987

# The Queen Charlotte Tundra!

## (Palynology and the Quaternary)




Palynology, or the study of fossil pollen and spores, has been widely used to reconstruct past floras and environments, and is particularly important in researching the ice age. Detailed reconstructions of changing climate, landscapes and plants have been made in many parts of the world for this period of geological time, allowing comparisons to be made at a local or international level.

Have you ever wondered how scientists are able to say with confidence that ice age hunters pursued mammoths and other big game over tundra or dry grasslands, in areas where the climate now favours growth of dense deciduous forests? Information on Quaternary environments comes from many different sources, involving the research efforts of geologists, climatologists, zoologists, archaeologists and others. The all-important plant cover, however, is usually re-created by the technique of pollen analysis.

Pollen and spores are important paleoenvironmental indicators. Most are microscopic, and may be produced in astronomical numbers. Wind-pollinated plants, like pines, spruces, birches, grasses, and many others, disperse their pollen widely, so that a mixed "pollen rain" settles out everywhere in the vicinity of the pollen-producing vegetation. Thus soils, bogs, waterbodies, glaciers, and all other surfaces (including the nasal passages of air breathers) receive this pollen fallout every year. In waterlogged environments such as bogs and lake bottoms, the pollen grains do not decay and continue to accumulate for thousands of years or even longer. The layers of mud that accumulate on lake bottoms are like pages in a book, with pollen and spores representing the print that tells the story of plant changes with the passage of time. To "read" these books, pollen analysts collect samples of mud or peat from a core and treat them with chemicals to remove sand, silt, humus and plant debris, leaving pollen-rich residues from various levels for analysis under a microscope.

The variety of shapes, sizes, and structures of pollen allows the plants that produced them to be identified, sometimes to species level. By identifying and counting hundreds of pollen and spores in each sample of a core, a detailed picture emerges of vegetation changes throughout time. Computers are now routinely used to help with the "number crunching" and interpretation of the large amounts of information generated, but the skill and botanical knowledge of the pollen analyst still determines the accuracy of the final reconstruction.

To illustrate the process, refer to the accompanying photographs, taken from a study of past environments of the Queen Charlotte Islands, a scientifically intriguing archipelago near the central coast of British Columbia. Figure 1 shows the present coastline at Cape Ball, on eastern Graham Island. In today's mild, wet climate, dense forests of Sitka Spruce, Western Red Cedar, Western Hemlock and pine grow behind the sea-cliffs, near the mouth of Cape Ball River. A surface sample containing the modern "pollen rain" produced by this vegetation shows the presence of hemlock pollen (Figure 2, top) and spruce (Figure 2, bottom), as well as many other types.

How and when did today's forests first appear? Cores of mud from lake bottoms (like Figure 3) or from buried ancient bogs exposed in the sea-cliffs of Cape Ball contain the answers. Pollen analysis tells us how, and radiocarbon dating of the organic sediments can tell us when (but only if they are less than about 50,000 years old). In the oldest sediments, deposited about 15,000 to 12,000 years ago, after glacial ice retreated from this area, the pollen assemblage is very different from that of today. Tree pollen are scarce or absent, but grasses, sedges, dwarf shrubs and other non-tree plants predominate. Several surprises turned up during pollen analysis of these early sediments. Figure 4 is a photograph (magnified nearly 1000X) of a fossil pollen grain of Jacob's-ladder, an attractive herb with blue flowers. Detailed study of the pollen (Figure 5) using a Scanning Electron Microscope revealed that the species represented was "Tall Jacob's-ladder" (Figure 6). This species no longer grows on the Charlottes, but is typical of rich mineral soils in Alaska and northern Canada.

When all the pollen data are considered together, the Cape Ball of 15,000 years ago most likely looked something like Figure 7, a tundra landscape from the northern Yukon. Beginning about 12,000 to 11,000 years ago, the Queen Charlotte tundra was gradually replaced by forests, initially Lodgepole Pine, followed by spruce, then hemlock, and lastly Western Red Cedar. The vegetation that now covers most of the islands has been present for no more than 5000 years.

Rolf W. Mathewes
Simon Fraser University
and
David M. Jarzen
NMNS Paleobiology Division

# Off the Press

***The Muskoxen of Polar Bear Pass***
David R. Gray

200 pp., 16 colour, 30 black-and-white illustrations
ISBN 0-88902-944-X
180 × 255 mm
$50. (HB)

*Édition française:*
*Les Boeufs musqués de la passe Polar Bear*
ISBN 0-88902-942-3

The muskox is a favourite exhibit in most natural history museums, perhaps because the remoteness of its arctic homeland surrounds it with an aura of mystery. Like the arctic environment itself, this stocky, long-haired mammal is of growing interest to the people of Canada.

Although most of us will never meet the muskox on its home ground, we can learn a great deal about this shaggy symbol of the north in *The Muskoxen of Polar Bear Pass*. This publication by Dr. David R. Gray of the Museum's Zoology Division offers unique information through the eyes of a veteran observer.

A broad, low valley stretching across Bathurst Island, Polar Bear Pass provides a life-support system for some of the highest concentrations of birds and mammals in the High Arctic, and was recently designated the first Arctic National Wildlife Area. Based on the author's long-term studies here, the book describes how the muskoxen of the Pass feed, play, fight, mate, rear their young, and defend themselves against their enemy, the arctic wolf. Dr. Gray weaves into the many fascinating details of the daily lives of muskoxen his personal story of living in a hut in the Pass for over 10 months, with only one other scientist for company.

Much of the data included in this profusely illustrated account of the life history and behaviour of a muskoxen population over a 10-year period has not been published previously. The book is of definite interest to naturalists and biologists, students, and anyone else who would like to learn more about the rugged Canadian arctic. *The Muskoxen of Polar Bear Pass*, co-published with Fitzhenry and Whiteside, is available in bookstores nationwide.

# Freeze-dried Mummies are Hot Items with Paleontologists

In *BIOME* Vol. 4:1 (1984), an article by Lauren Walker, *The "Moon-Egg" that Contained an Arctic Ground Squirrel*, was an instant attention-getter. The "moon-egg" turned out to be a mud-encased mummified arctic ground squirrel found in 1981 by a goldminer in the Sixtymile area near Dawson, Yukon Territory, and sent to Dr. Dick Harington, the Museum's Curator of Quaternary Zoology. At that time, Dick speculated that the squirrel had died during hibernation, perhaps more than 10,000 years ago, near the end of the last glaciation. To have obtained a radiocarbon date of the specimen would have meant destroying it, since several hundred grams of organic material were required. So the mummy remained untouched, stored among the thousands of fossil specimens.

During the summer of 1984, while collecting fossils in the vicinity of Sixtymile, Dick was given a carcass of a mink-sized member of the weasel family. The owners of a placer mine, Lynn and Chuck McDougall, had taken the animal away from Molly, the family dog, and donated it to the NMNS. Since the carcass was partly fur-covered, it could have been ancient or merely a leftover from the previous year's trapping season.

When I unwrapped the specimen, in 1985, I realized that it was a mummified black-footed ferret, long extinct in Alaska and the Yukon. During the previous month, I had collected a thirteen-hundred-year-old fossil jaw of this species from the northern Yukon. The mummy, an adult male ferret, is exceptionally well preserved; the colour of the remaining fur differs little from pelts of ferrets trapped thirty years ago. An X-ray showed that the ferret had remains of its last meal still in its intestine, so I dissected it and found what appears to be mouse fur.

A new method of radiocarbon dating, called accelerator mass spectrometry, was developed in 1977 and became available in Canada in 1984. Since only a few grams of organic material need be sacrificed, a very small sample of ferret bone was sent to the Isotrace Laboratory at the University of Toronto. A few weeks later, the specimen was dated at about 40,000 years old! This was a tremendous surprise; I had guessed approximately 20,000 years, but was beginning to get cold feet about that estimate, since the specimen is so well preserved. Bits of muscle from the mummy were also sent to a lab in California with the hopes that some DNA may be recovered and compared with that from the living black-footed ferret, and near relatives in Eurasia.

Later, Dick Harington submitted a small sample of skin and hair from the "moon-rock" arctic ground squirrel for accelerator dating, and likewise was surprised by the age of about 47,000 years reported by a Swiss laboratory. Dick and I believe that the broadly similar ages and close physical proximity of the two mummies may indicate that the deaths and preservation of both animals may have occurred during a relatively dry climatic event in the middle of the last glaciation of northwestern North America, which lasted from about 100,000 to 10,000 years ago.

The "muck" in the Dawson region certainly hides more treasures than gold. Dick dreams about finding an entire mammoth or saiga antelope, and sometimes I fantasize about finding a freeze-dried short-faced skunk or ice-age lion. With continued field work, a bit of luck, the continued support of Yukon gold miners, and a rise in the price of gold, our dreams may just come true.

P.M. Youngman
Paleobiology Division

# The Qualicum Walrus

One morning in 1979, while collecting shellfish north of Qualicum Beach on Vancouver Island, Bill Waterhouse saw tusks protruding from the clay of a boulder-strewn beach. He tugged at the tusks and pulled up part of a skull.

Bill's daughter took the skull to her teacher, Graham Beard, who had been collecting fossils in the region for many years. She said her father had found the "lower jaw of a sea lion." Fortunately Bill had pinpointed the site and was able to lead the teacher there. Over the next few weeks, Graham returned to the site during low tide to excavate the specimen — most of a walrus skeleton, which had been buried lying on its back. Except for the vertebrae and ribs, most of the bones were well preserved.

I heard about this exciting find from Rick Kool of the British Columbia Provincial Museum, and I arranged to examine the bones and visit the site in September 1980. Graham showed me the many bones he had collected and carefully laid out in his garage. He kindly agreed to donate the specimen to the National Museum of Natural Sciences — partly because the provincial museum lacked the technical staff to restore and mount it.

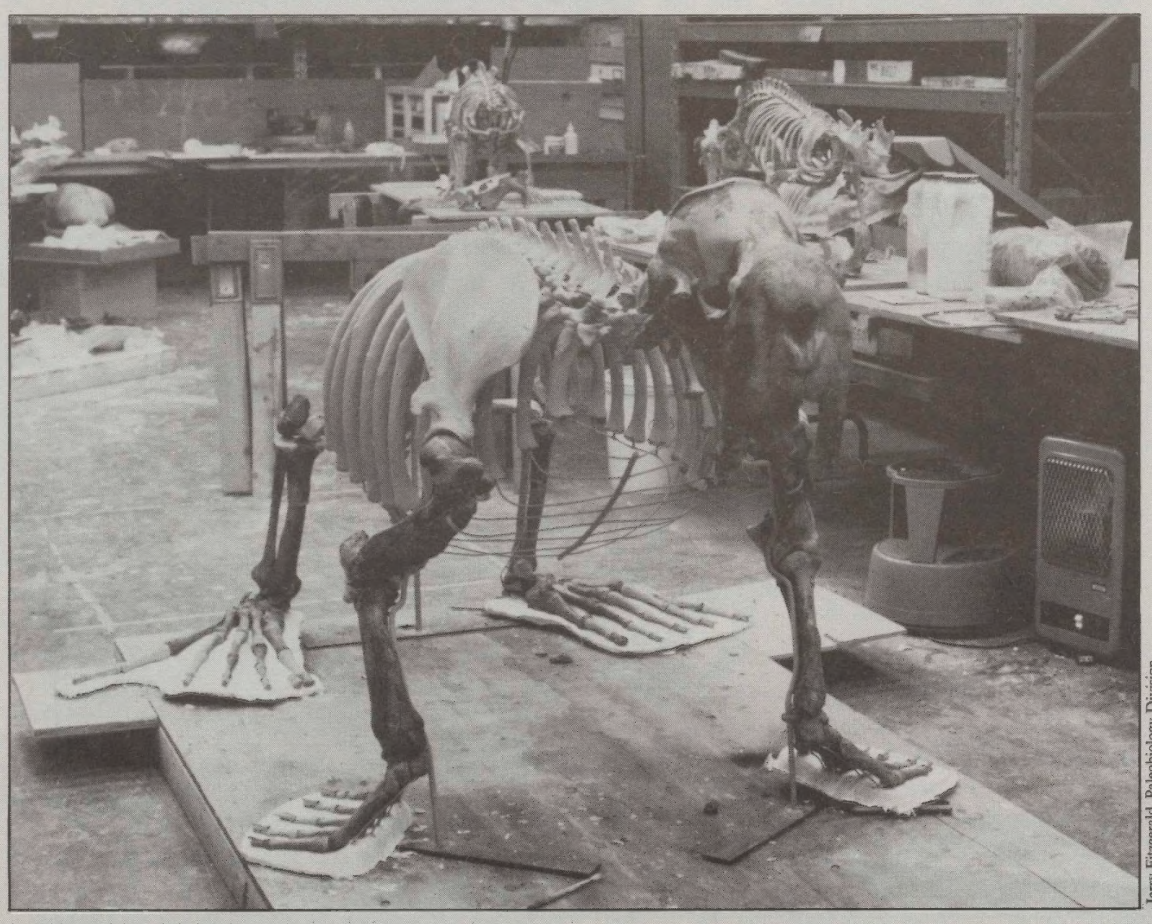
The fossil locality was covered with boulders due to tidal action, despite the fact that they had been cleared away earlier. Soon we found chips of bone and began heaving boulders aside. We found several fragmentary vertebrae and ribs, and eventually I found what I was seeking — a rib clearly embedded in the marine clay unit that ran under the coastal bluffs nearby, where it lay beneath about 60 m of ice age sediments. While I was removing a block of clay below the rib for microorganic analysis, the tide came flooding in behind me. We escaped quickly, but not before measuring the thickness of the layers of ice age sediments (stratigraphy) exposed in the coastal bluffs behind the beach.

I soon received a radiocarbon date on a walrus rib indicating that the skeleton was more than 40,000 years old. This coincided with stratigraphic information on the age of the clay from Dr. Steve Hicock (University of Western Ontario), who had studied the local geology for several years. He estimated that the marine clay was perhaps 60,000 years old. Dr. John Fyles (Geological Survey of Canada), who had studied the sediments in the 1950s, considered the marine clay had formed near the shore and showed signs of being influenced by floating sea ice. Further, the kinds of seashells collected from the clay live today in the southern Bering Sea nearly 3000 km to the northwest — which approximates the southern limit of Pacific walrus range. In other words, the Qualicum walrus fitted well with our knowledge of the habitat of modern walruses and of the paleoenvironment of the area about 60,000 years ago based on other kinds of evidence.

This spring, Jerry Fitzgerald and I finished mounting the Qualicum walrus, with help from Barbara Frizell and Valerie Vail, who cast the vertebrae and ribs from a modern walrus of similar size. Skull measurements (particularly the small tusks) indicated that it belonged to an adult female. With the help of S.L. Presley (Archaeological Survey of Canada), I managed to get some excellent photographs of a section cut from a tooth. (You can read rings in the teeth like tree rings.) Evidently, the female had been in her twelfth year when she died, rolled over and sank in the frigid inshore waters some 60,000 years ago.

The moral of this story is that, usually, it takes more than two to do the paleobiology tango. This study involved: an observant shellfish collector, a curious daughter, a teacher and keen amateur fossil collector, an alert provincial museum docent, a geochronologist to supply the radiocarbon date, two dedicated ice age geologists, a NMNS paleobiologist, experts in ice age marine shellfish and diatoms, a paleobiology technician, an archaeology technician, two museology student assistants ... and perhaps a few more that I have forgotten! The result is one of the best-preserved ice age walrus skeletons in the world; one that shows clearly that walruses lived far south of their present range during ice age glacial advances; and an excellent skeletal mount ready for display in a new and expanded National Museum of Natural Sciences *Life Through the Ages* gallery.

C.R. Harington
Paleobiology Division



Jerry Fitzgerald, Paleobiology Division

*Final stage of mounting the Qualicum walrus, one of the best-preserved ice age walrus skeletons in the world.*